# Linked Radar Study

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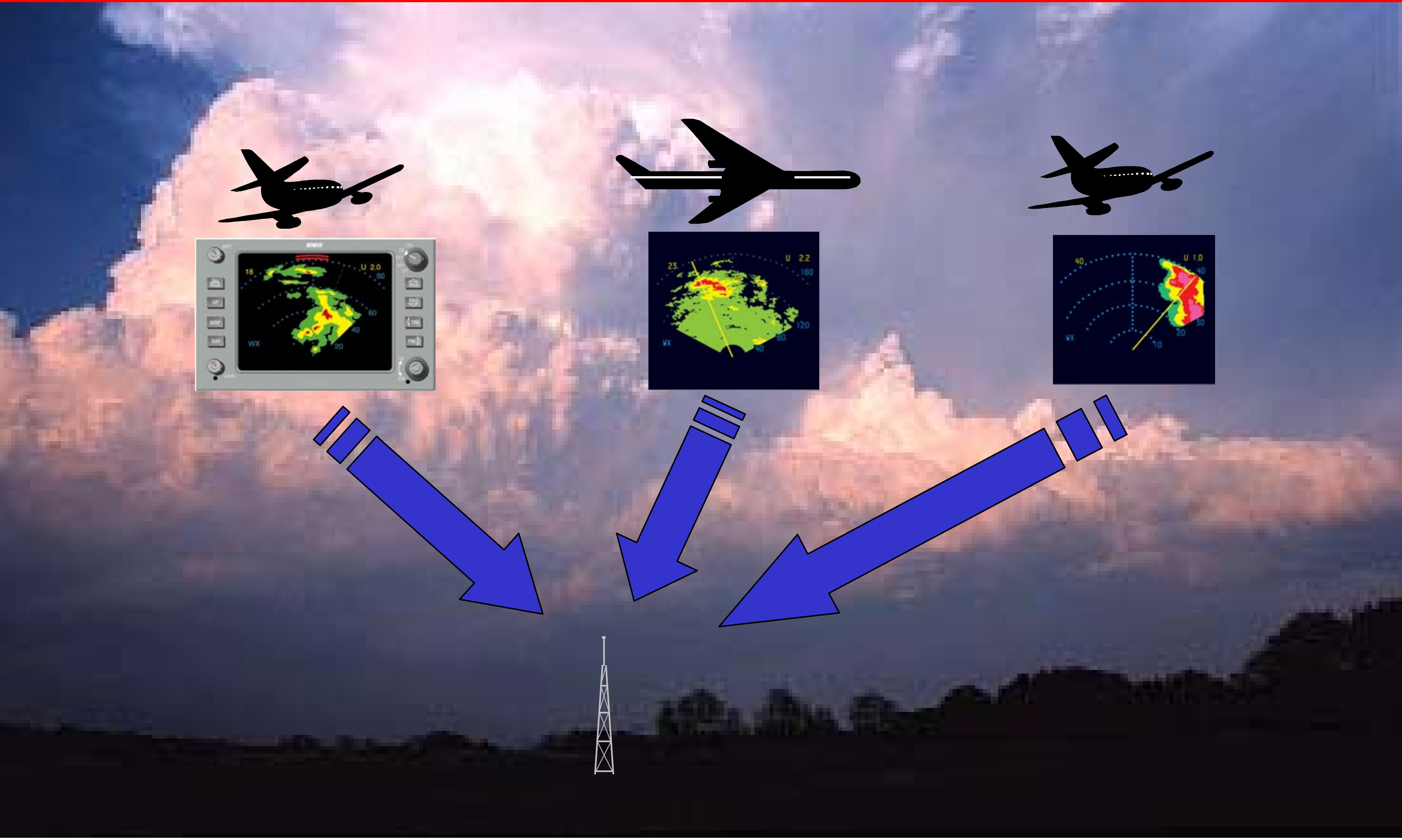
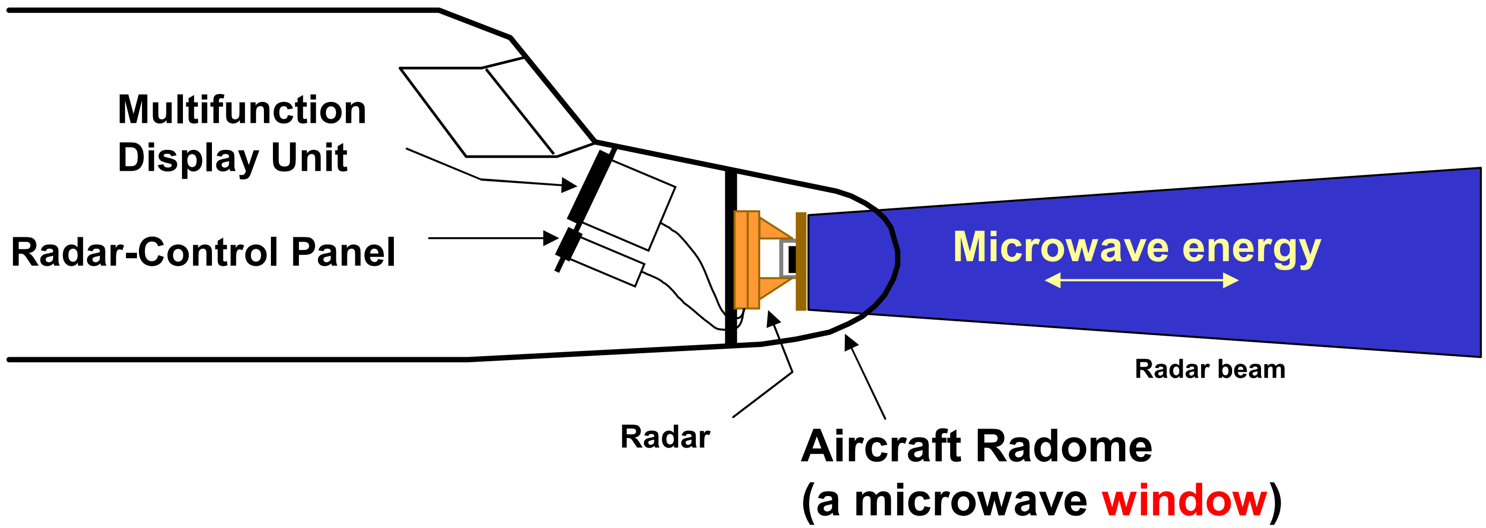
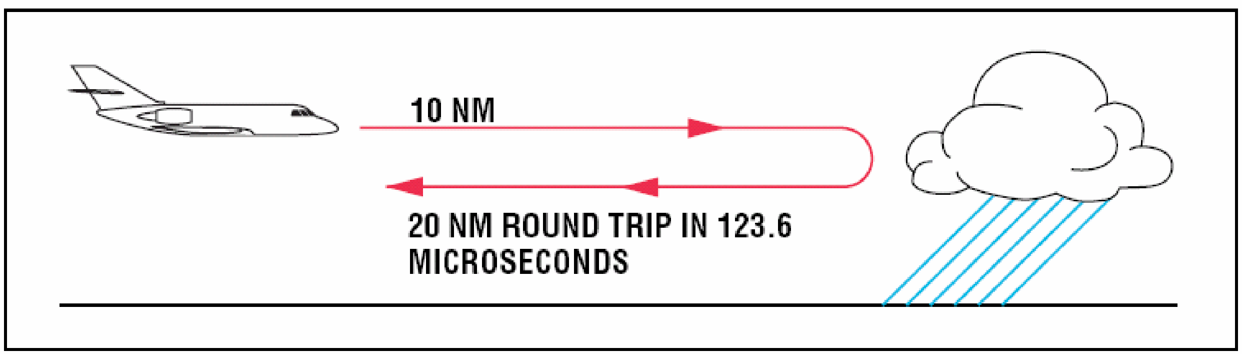
Honeywell

# Linked Radar Study

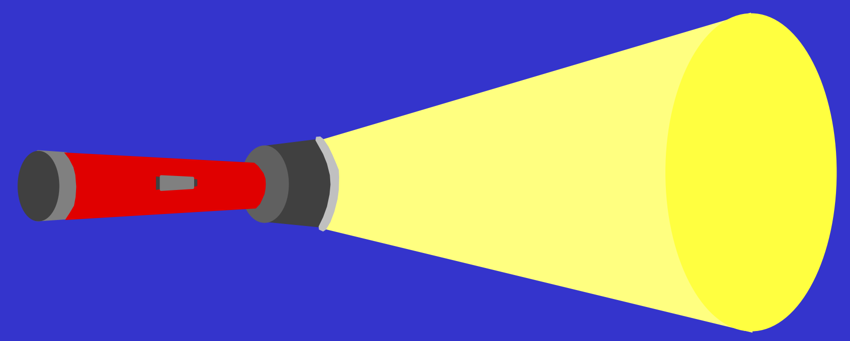


# Radar Fundamentals

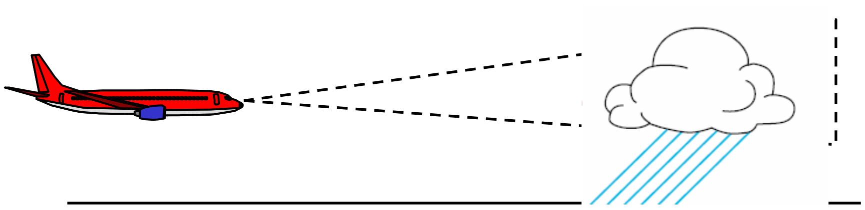


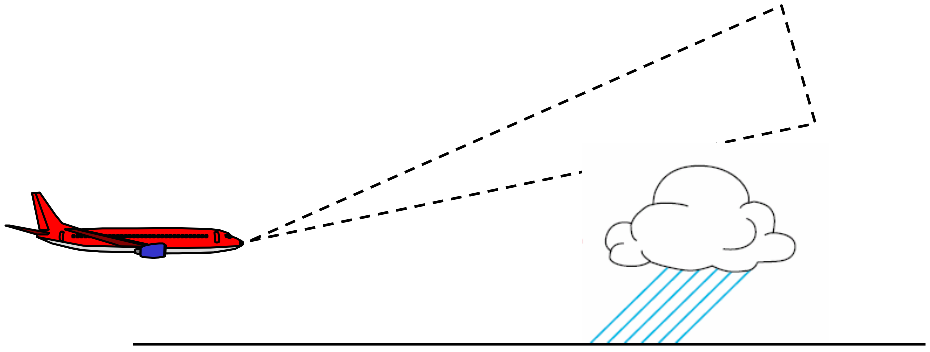
# Flashlight Analogy



Radars can only see what is inside the illuminated beam

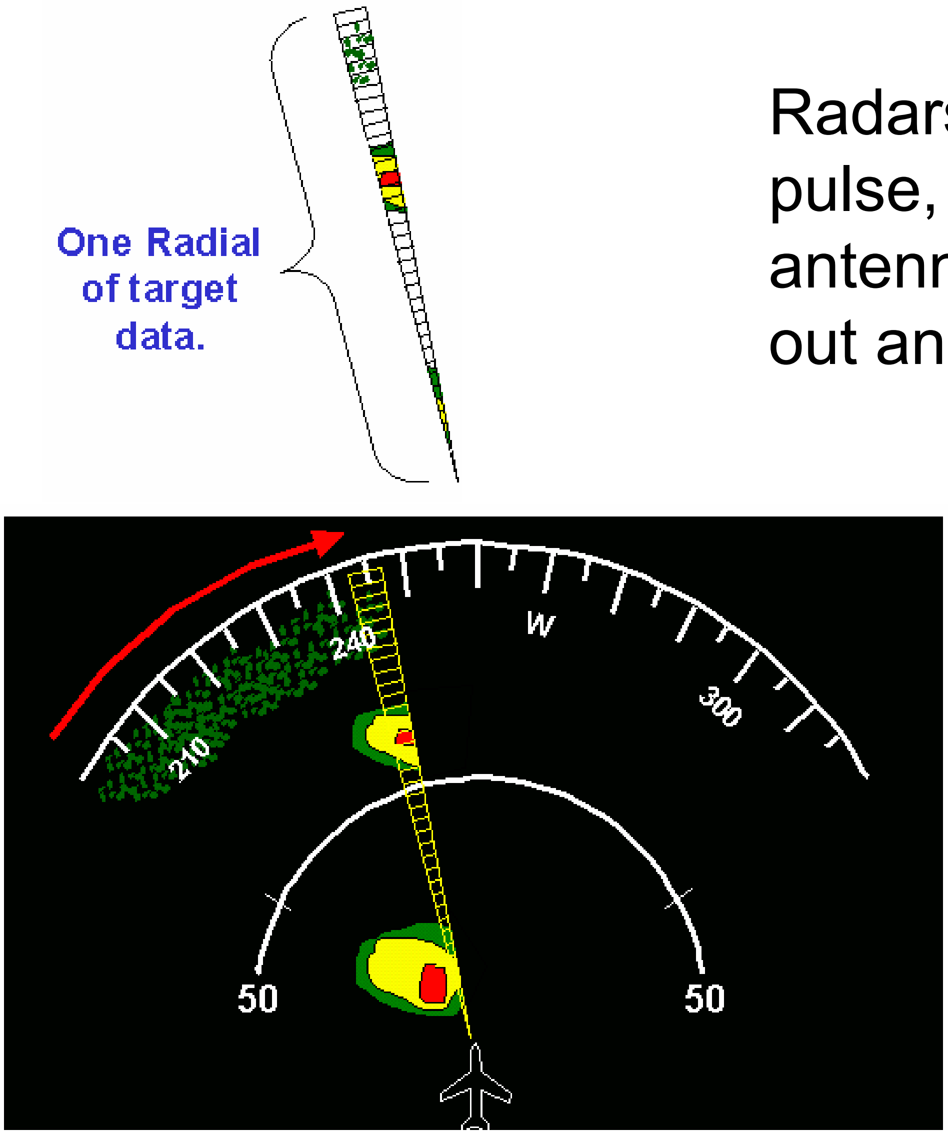


**Storm Illuminated by Radar**



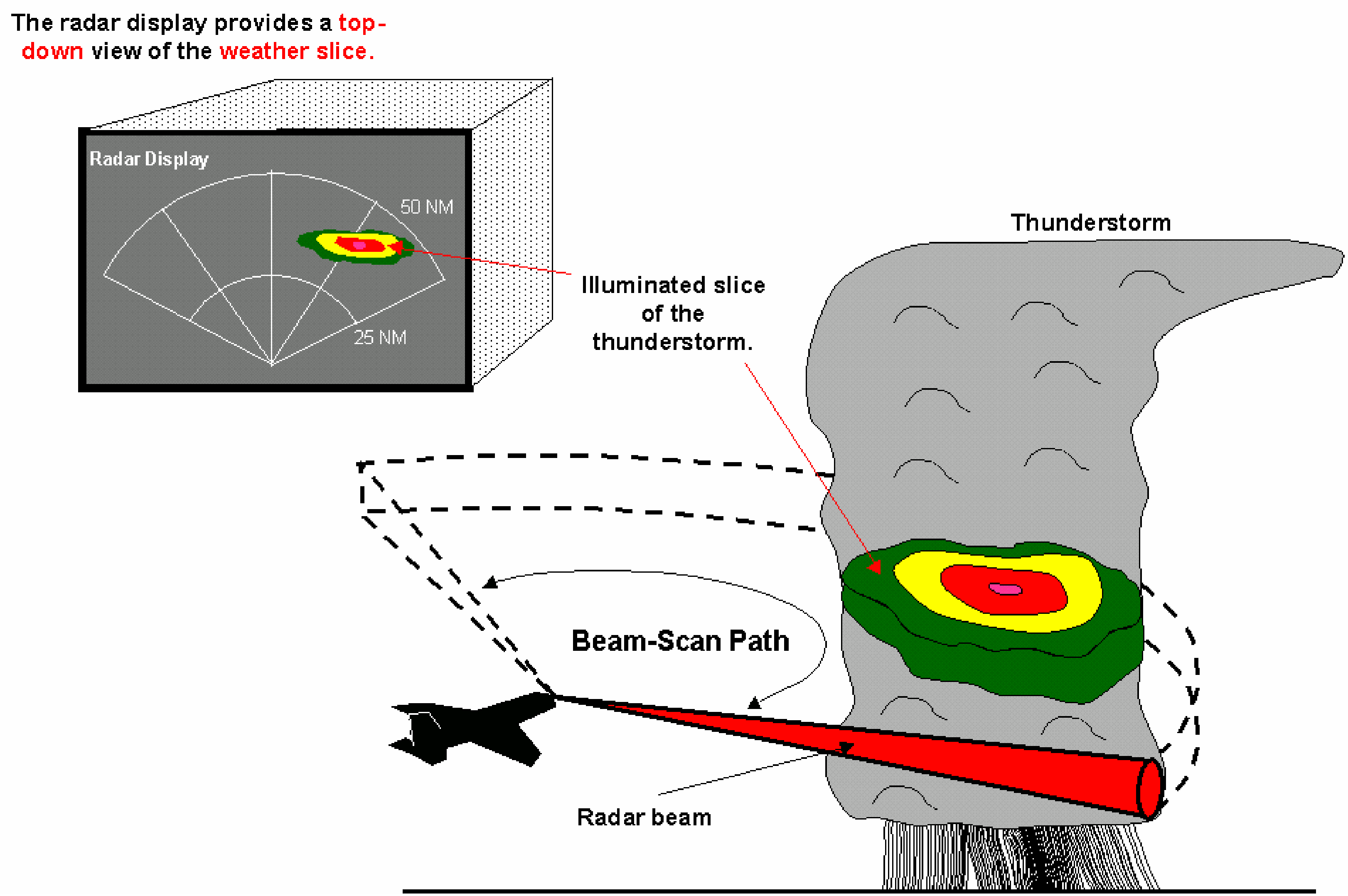
**Storm <u>Not</u> Illuminated by Radar**

# Radar Sweep Process




Radars send out a pulse, move the antenna, then send out another pulse.

# Radar Sweep of a Thunderstorm



# Hypothesis

- If we could downlink all the airborne radar data from all the aircraft in flight, we would be able to provide very useful data to forecasters and the aviation community.

# Objective of the Study

- Take a preliminary look at the coverage of the data that would be made available if all the Air Transport radars were downlinked.
- Identify the key airborne radar issues that need to be taken into account.

# Procedure

- Map out the radar coverage in the Continental US for a number of different times of day
  - Use actual airplane position data to give 'snapshots' of different points in time
  - Map CONUS coverage assuming that all Air Transport aircraft participate by downlinking their radar data
  - Assume the radar data is valid for 7 minutes (same update rate as NEXRAD)

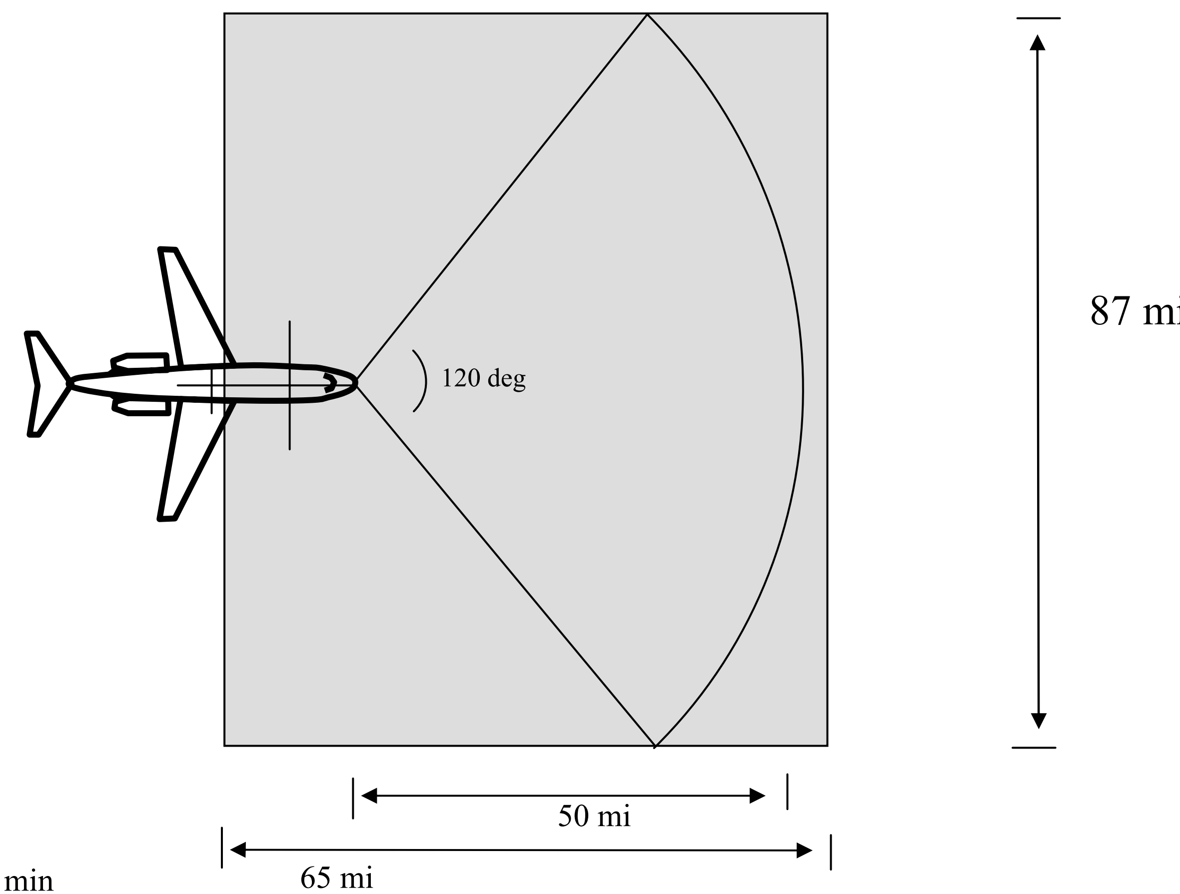
# Delimitations

- Aircraft positions are based on 2000 data
- Assume all aircraft are traveling at the same speed (530 mi/hr)
- In order to simplify the preliminary coverage analysis, assume all aircraft are travelling due North or due South.
- BA and Air Cargo aircraft were not included in the analysis

# Radar Coverage Analysis

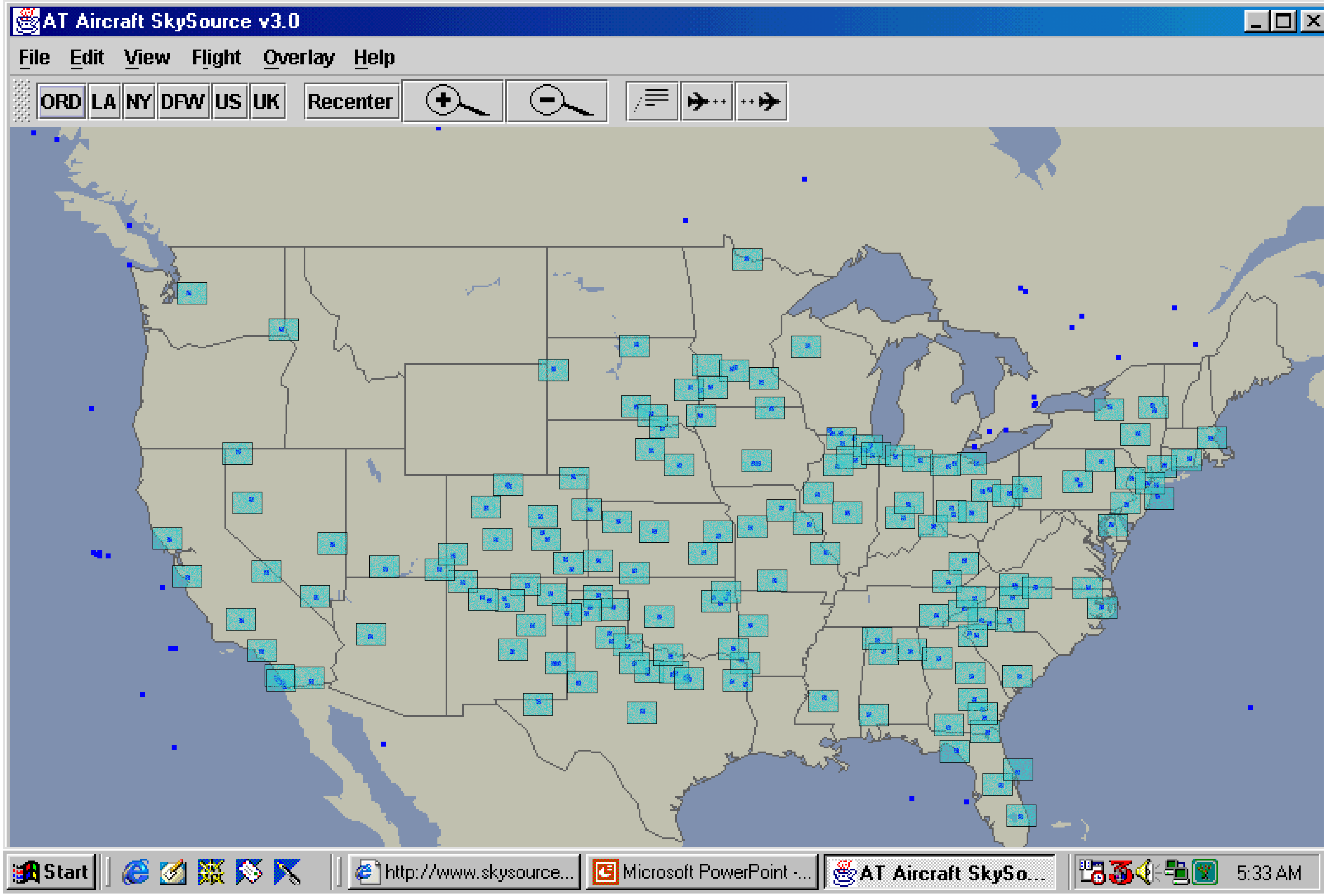
- Assume all aircraft fly at 530 mi/hr
- Assume all radars have a 28 in dish, operate in X-band, have a 120 degree sweep, and have equivalent performance.
- Aircraft altitude and radar tilt were not considered in the coverage analysis
- Assume a 50 mile STC ‘Calibration’ range

# Radar Coverage for Each Aircraft




Aircraft speed = 530 mph
Data validity = 7 min
Aircraft moves ~ 65 mi in 7 min

# AT Aircraft Traffic




August 27, 2000

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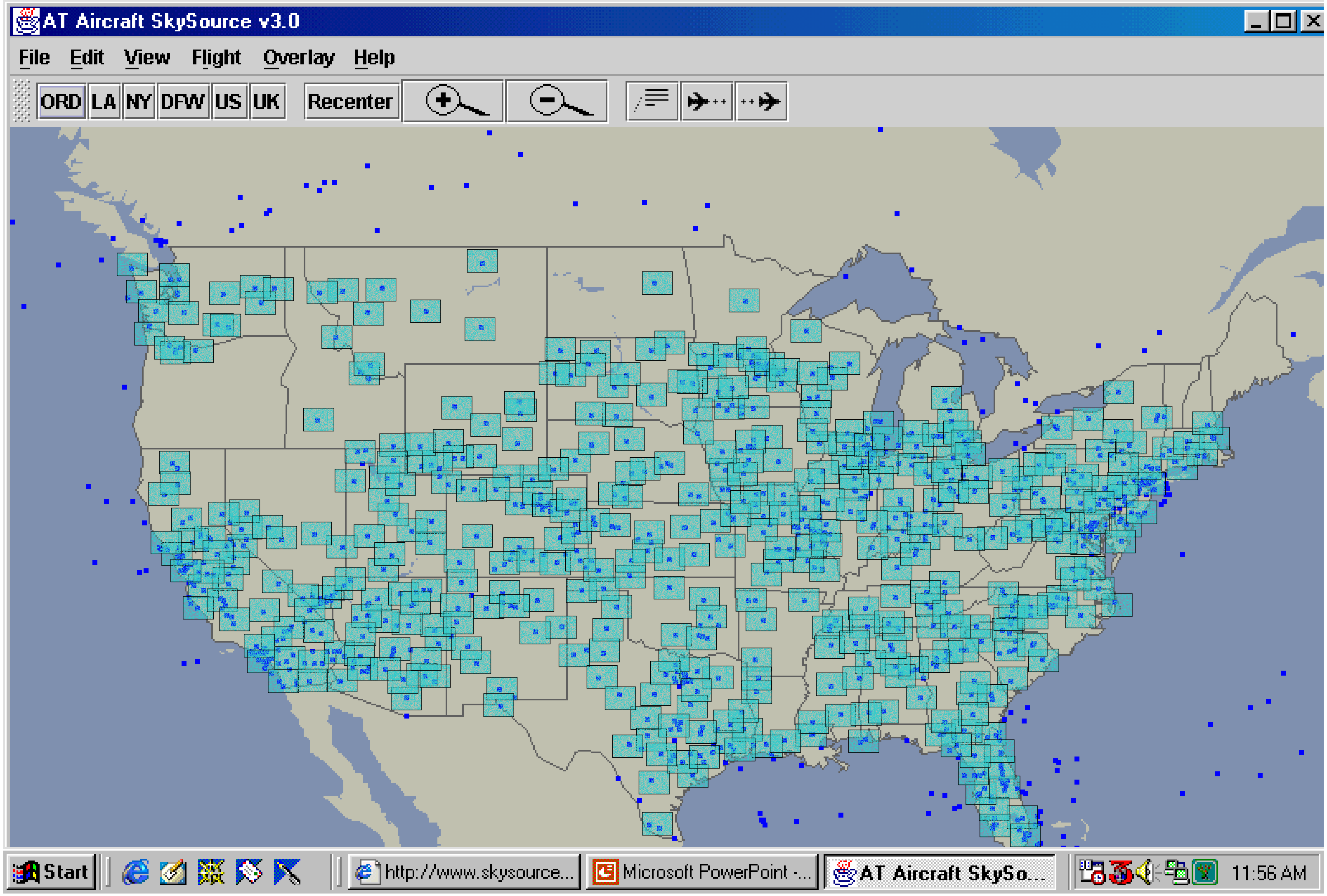
# AT Aircraft Traffic

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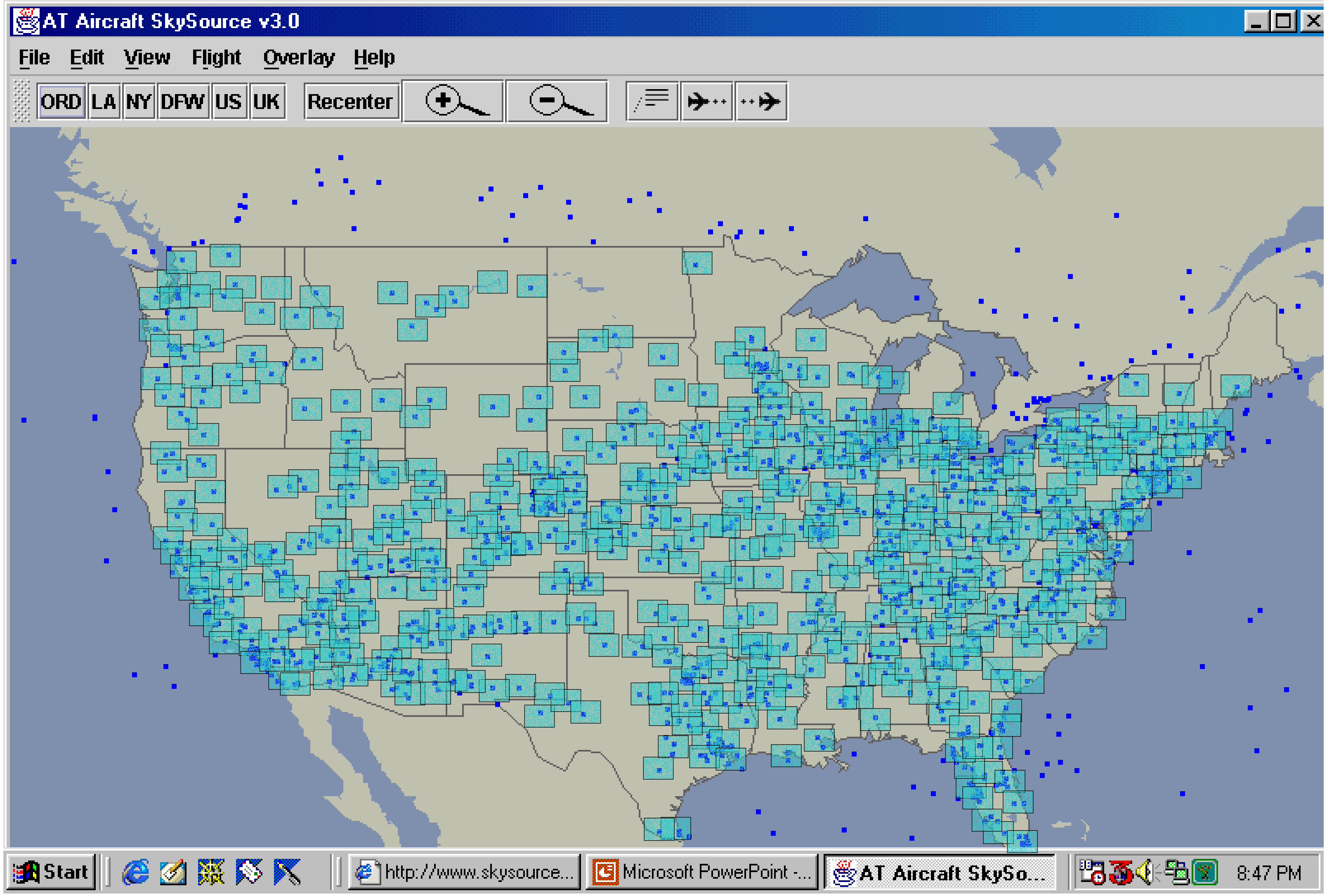
# AT Aircraft Traffic

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# Observations

- Coverage varies throughout the day as traffic volume changes
- Gaps in coverage exist even during the highest traffic times

# Coverage Issues

- Coverage will be non-determinant
  - Planes won't be in exactly the same place at the same time every day
  - Weather events likely to affect traffic patterns
- Gaps in coverage
  - A handful of airports handle the majority of the Air Transport traffic

# Radar Concerns

- Airborne Considerations
  - Ground Returns vs Weather Returns
    - Tilt Management
  - Altitude Rings
- Limitations
  - Power
  - Beamwidth

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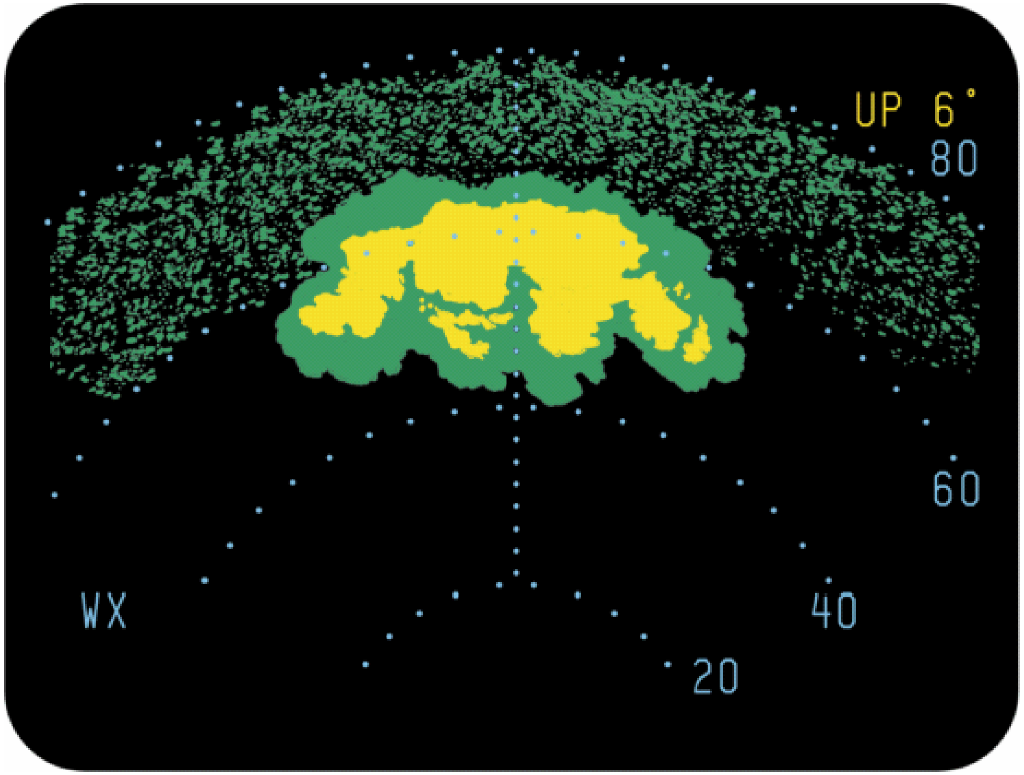
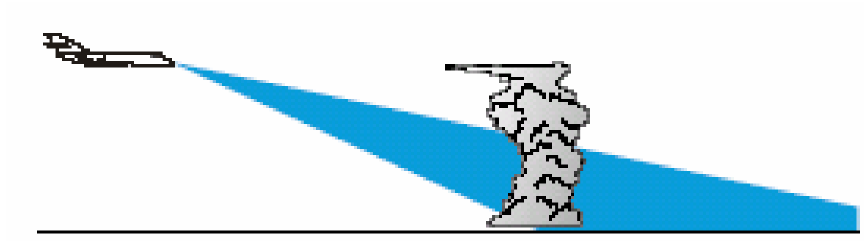
# Ground Clutter

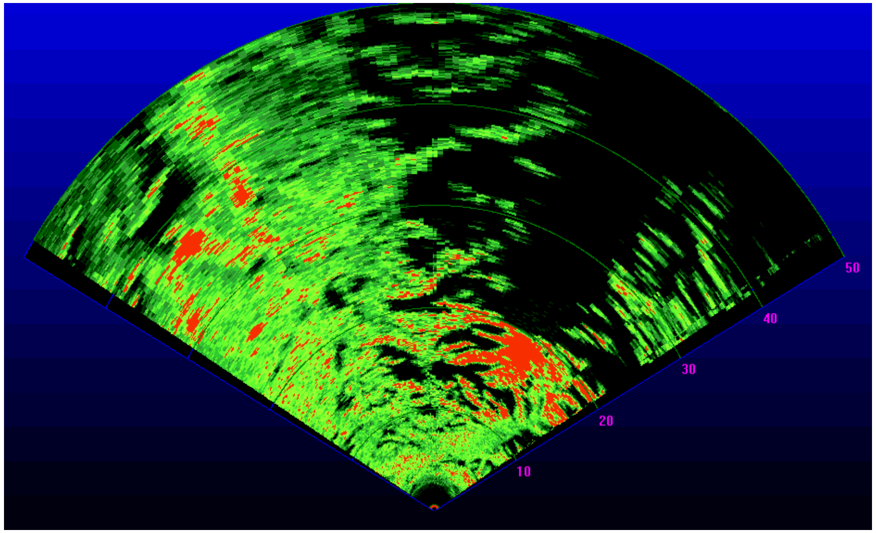



Pilots are trained to keep a little bit of ground clutter at the edge of the display

- Confidence check
- More likely to illuminate weather

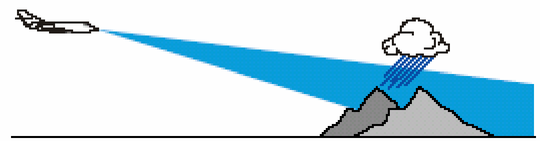


# Ground Clutter



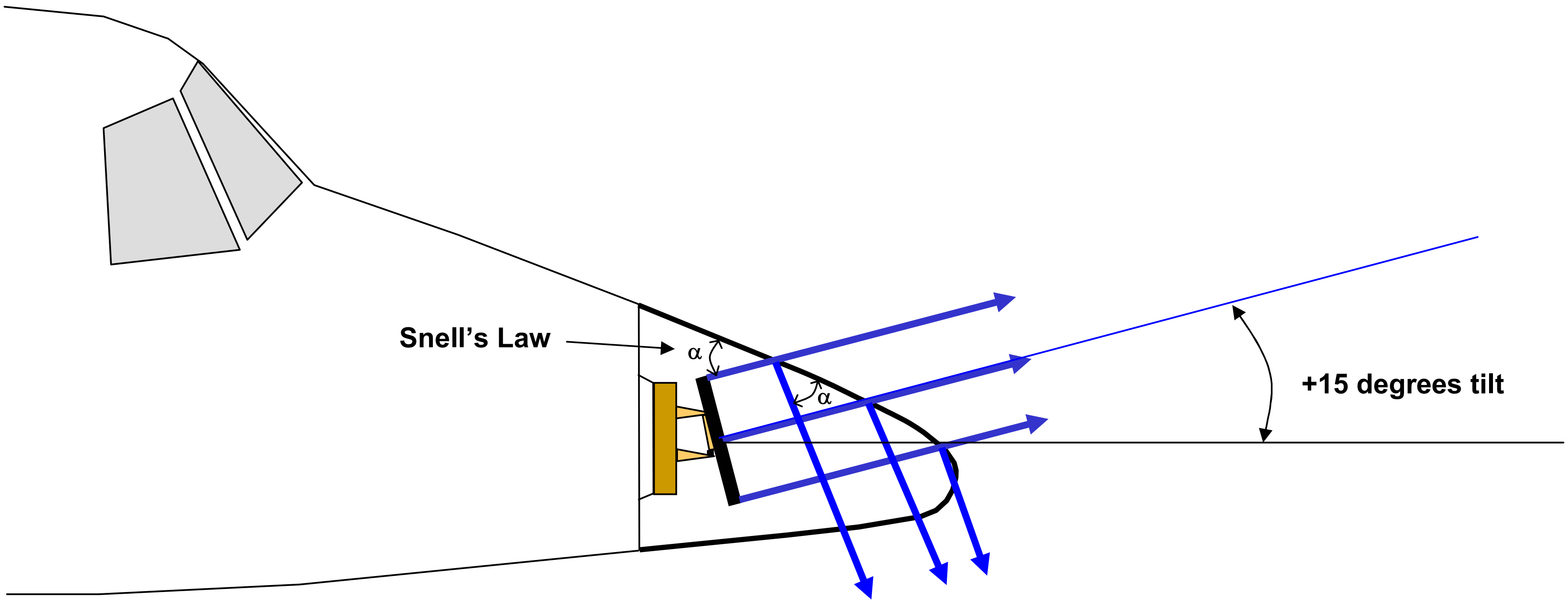


Ground returns only



Weather and ground returns

# Altitude Ring



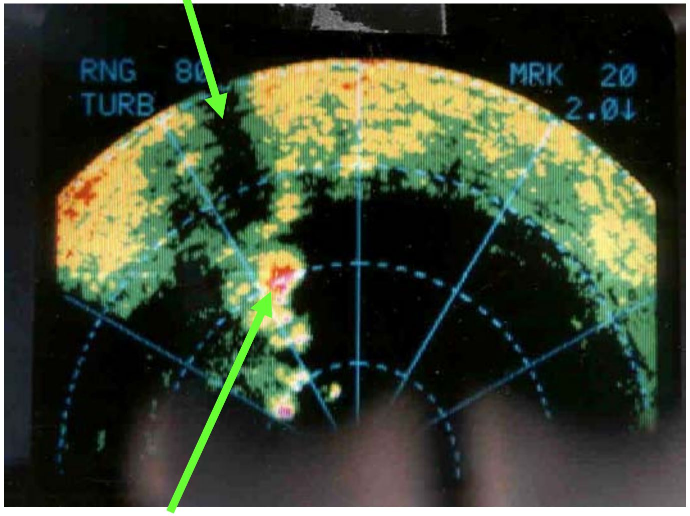

**The energy will travel almost straight down to the earth and back.**

# Altitude Ring Example


**Notice the "altitude ring" is located at about 7 NM. The aircraft is 6.9 NM above the ground.**

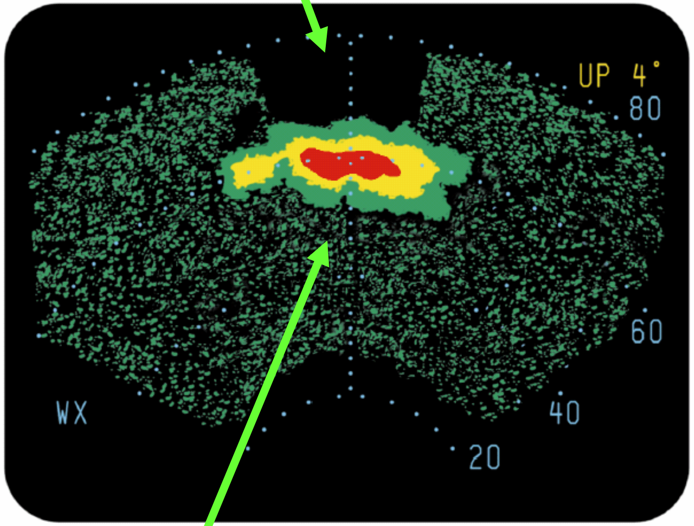
# Airborne Radar Power Limitation

A radar shadow caused by weather attenuation.

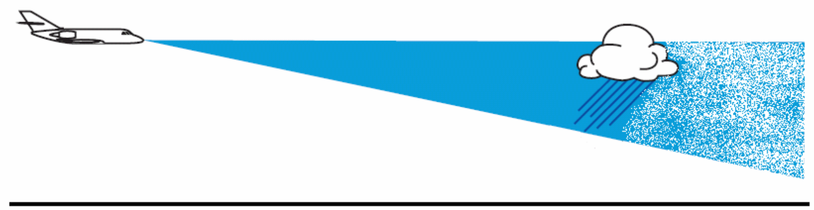



A thunderstorm is located forward of the radar shadow.

Radar Shadow




Thunderstorm



Can’t always see the “weather behind the weather”

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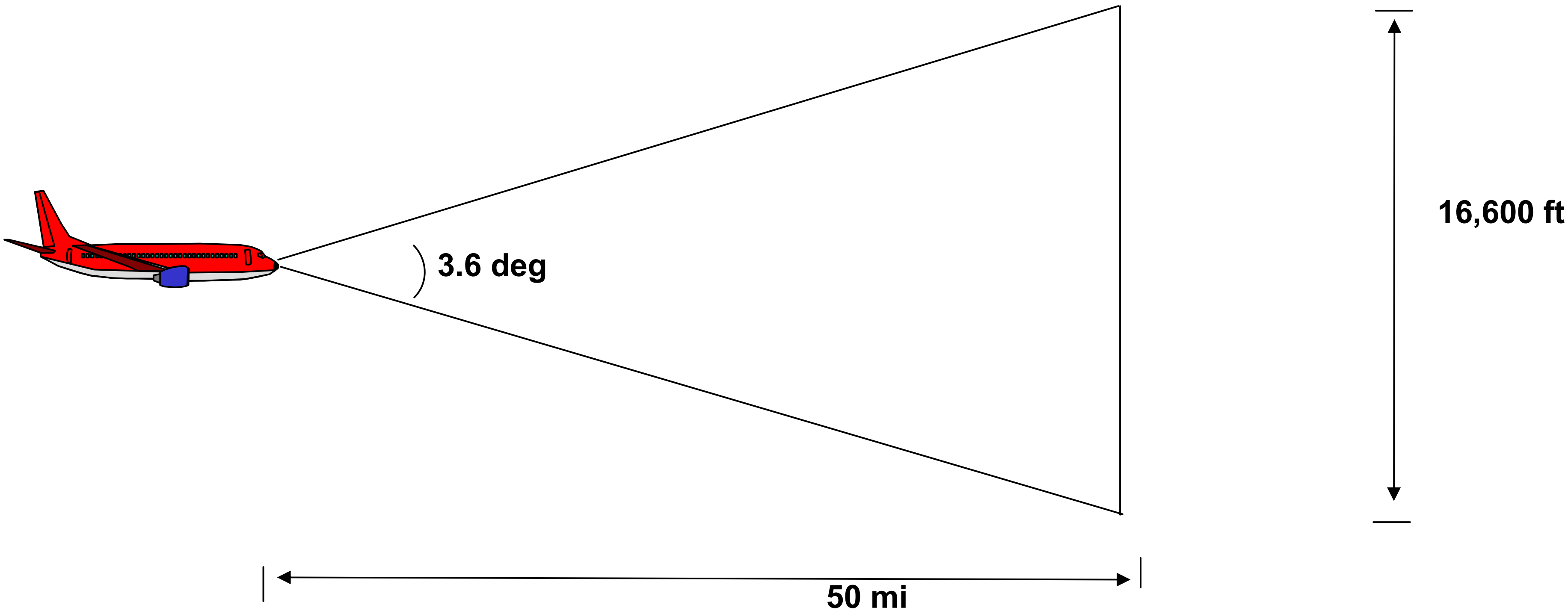
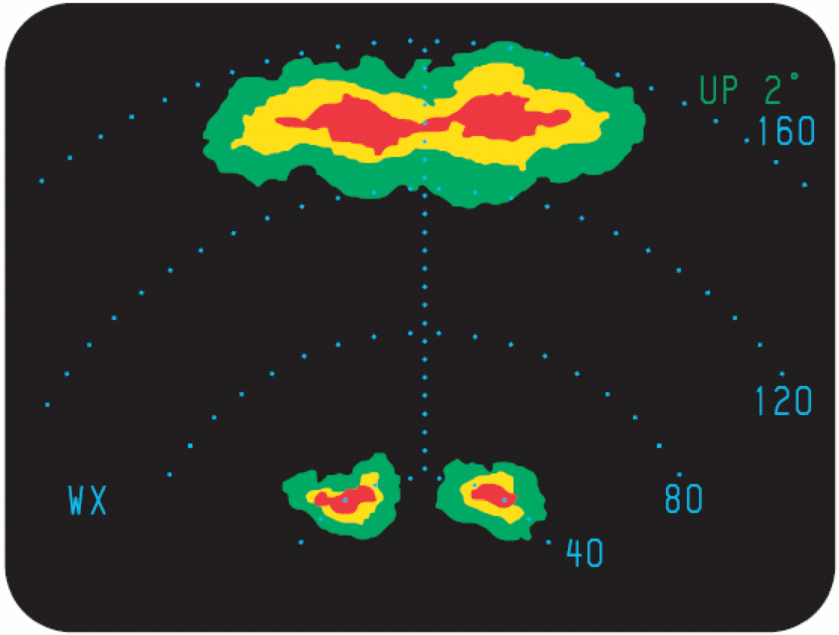
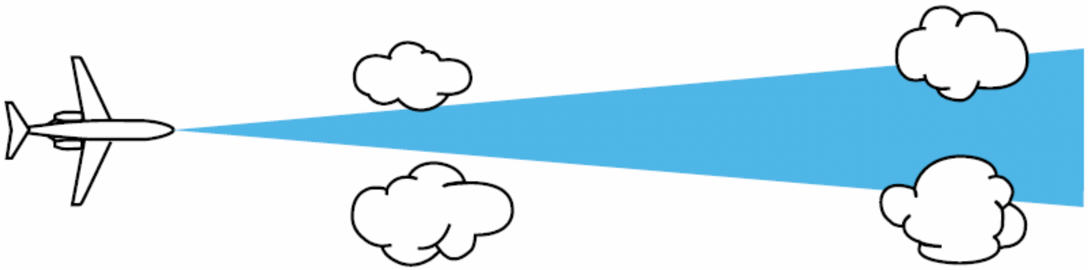
# Radar Beamwidth

X-band, 28 inch diameter antenna



# Beamwidth - Horizontal Considerations



# Conclusion

- Recommend bringing geographic coverage data to meteorological community
  - Gaps in coverage
  - Non-deterministic coverage areas
  - Coverage variance throughout the day
- Need to make sure to consider airborne radar parameters and issues before implementing weather radar downlink.